

The MET(Microwave Electro-Thermal) Thruster and Mars Missions

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The MET uses an electrodeless, vortex-stabilized, microwave discharge to superheat water vapor for propulsion [1,2]. The MET uses robust, ultra-efficient microwave sources and water as propellant to produce the specific impulse or I_{sp} of greater than 800 sec. Because of its electrodeless design it has high system efficiency with an I_{sp} that is high but still lower than Hall thrusters, the MET, has a high thrust per unit power: T/P of 0.2N/kW. Because of the use of water propellant, it can enable beamed power, low-cost refuelable Mars architectures. The MET is highly scalable, with MET thrusters run at 100 W at 7.5 GHz, 1 kW at 2.45GHz, and at 75 kW at 915 MHz. The latter version, using 915 MHz, using magnetrons at 95% DC to RF efficiency, has been run on water vapor (Fig. 1, 2), This technology is also being explored by the PRC [3,4]. Defining $I_{sp}=V_{ex}/g$, Thrust : $T= \dot{M}_t V_{ex}$ and Thrust kinetic power, $KP=\frac{1}{2} \dot{M}_t V_{ex}^2$ and Efficiency η , $KP=\eta P$, it is seen that Thrust per unit Power: $T/P=2\eta/(gI_{sp})$ and must be traded. “McBride” Code supports water I_{sp} . This technology can increase payload for Mars Missions.

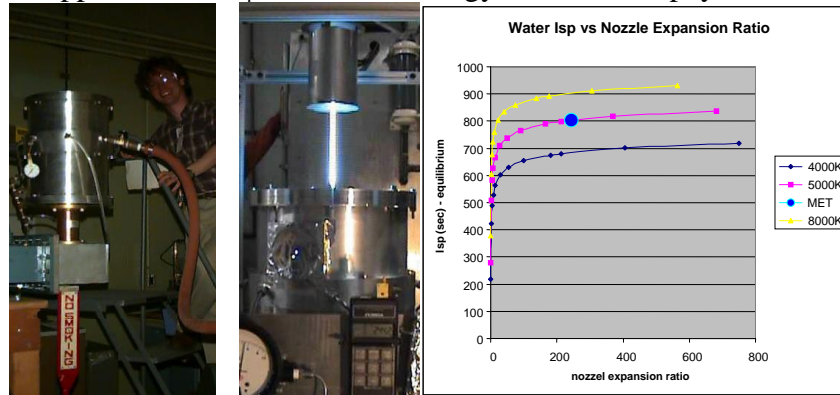


Figure 1,2,3 (l. to r.) 915MHz MET using water. McBride water I_{sp} vs Expansion Ratio.

[1]John .E. Brandenburg, John Kline, and Daniel Sullivan (2005) “The Microwave Electro-Thermal (MET) Thruster Using Water Vapor As Propellant” IEEE Trans. Plasma Sci. 33, 2, p776. [2]“High Power Microwave Electrothermal Thruster Performance on Water”, Brandenburg J.E, Diamante, K.D., R.B. Cohen, AIAA 2002-3662, 2002.[3] Lingyun Hou. et al. (2010)“Improvement on Stability of Water Arcjet” IEEE Trans. Plasma Sci. Vol. 39, 1 [4] Xia Guang-quing et al. (2007)“Experimental Investigation of Influencing Factors for Reliable Startup and Steady Work of 100W Microwave Plasma Thruster” IEPC-2007-264 2007